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SPECIAL ISSUE: LINKING VA AND NON-VA DATA TO ADDRESS US VETERAN
HEALTH SERVICES ISSUES

Reliance on Medicare Providers by Veterans after Becoming Age-Eligible for Medicare is Associated with the Use of More Outpatient Services

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Objective. To estimate the effect of Medicare use on the receipt of outpatient services from 2001 through 2015 for a cohort of Veterans Administration (VA) users who became age-eligible for Medicare in 1998–2000.

Data Sources/Study Setting. VA administrative data linked with Medicare claims for veterans who participated in the 1999 Large Health Survey of Enrolled Veterans.

Study Design. We coded each veteran as VA-reliant or Medicare-reliant based on the number of visits in each system and compared the health and social risk factors between VA-reliant and Medicare-reliant veterans. We used bivariate probit and instrumental variables models to estimate the association between a veteran's reliance on Medicare and the receipt of outpatient procedures in Medicare and the VA.

Principal Findings. Veterans who chose to rely on the VA ($n = 4,317$) had substantially worse social and health risk factors than Medicare-reliant veterans ($n = 2,567$). Medicare reliance was associated with greater use of outpatient services for 24 of the 28 types of services considered. Instrumental variable estimates found significant effects of Medicare reliance on receipt of advanced imaging and cardiovascular testing.

Conclusions. Expanded access to fee-for-service care in the community may be expensive, while the VA will likely continue to care for the most vulnerable veterans.

Key Words. Veterans Administration, medicare, ambulatory procedures, community care

Demand for care has overtaken the capacity of the Department of Veterans Affairs (VA) health care system to provide care, resulting in unacceptably long wait times for care at many VA facilities. Passage of the Veterans Access, Choice and Accountability Act of 2014 ("Choice Act") and its extension in

2017 provides veterans the option to use non-VA providers if VA care cannot be provided in a timely manner or if the veteran lives more than 40 miles from a VA-based provider.

Long wait times have fueled a larger debate about the most appropriate balance between VA-provided and community-provided care for veterans. VA has been transforming toward a model of care (Shulkin 2017) that continues to support a robust VA-based clinical program for essential services and coordinates with community providers to fill the gaps for needed services that VA clinicians are not able to provide. Under this model, VA clinicians retain an important role coordinating care by working with veterans to recommend either receiving care at the VA or through community providers based upon his or her needs and the resources available in the community. There are, however, proposals to extend this model to permit eligible veterans to receive care from any Medicare-participating provider that would be paid for by the VA without consulting a VA provider and with no restrictions based on distance of residence from a VA facility or wait times. These opposing models of care give rise to important questions. First, what are the characteristics of veterans who would choose to continue to rely on the VA if they were given a choice to use VA or community providers? Second, since current policies reimburse community providers on a fee-for-service basis, would veterans who chose to rely on community providers receive a more intensive and expensive style of health care?

We can gain insights into these issues by evaluating the care provided to Medicare-eligible veterans when they turn 65 and can choose to continue to use VA providers or to receive fee-for-service care in the community. To this end, we analyzed data from a cohort of veterans who participated in the 1999 Large Health Survey of Enrolled Veterans (LHSEV) (Selim et al. 2010) and who became age-eligible for Medicare sometime from 1998 to 2000. We

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examined their use of services from the VA and from Medicare during the period 2000–2015. We studied the characteristics of veterans who chose to rely on Medicare rather than the VA for most of their care, and we compared the survival and use of health care services between Medicare- and VA-reliant cohorts. We hypothesized that this information would be helpful in anticipating the effects of more extensive use of VA-paid community care by VA users.

METHODS

Data Sources and Study Population

We examined data from the Large Health Survey of Enrolled Veterans (LHSEV), which was linked to VA and Medicare administrative data through a “scrambled” social security number (SSN). Administrators at the VA and Medicare employ an algorithm that uniquely maps any SSN to a number that contains no identifying information. These “scrambled” SSNs were used to link the LHSEV with Medicare and VA administrative data.

The LHSEV was a cross-sectional survey of a stratified random sample of 493,647 veteran users identified in the summer of 1999. The core survey collected information on self-reported health risk factors; social risk factors, including marital status, social support, and food insecurity; and health behaviors, including smoking, alcohol consumption, and physical activity. It is available to VA researchers through the usual research process.

We restricted our sample to LHSEV respondents who became age-eligible for Medicare from 1998 to 2000, around the time they were surveyed, so we could reasonably treat their survey responses as reflecting their characteristics near the time they were making the decision to rely on the VA or Medicare. We included veterans who were eligible for Part A and enrolled in Medicare Part B at some time in 2000. Because Medicare Advantage plans do not routinely submit encounter-level claims for beneficiaries, we excluded veterans who were continuously enrolled in a Medicare Advantage plan in 2000. We excluded veterans who lived in Alaska or U.S. territories because the long distances to VA facilities made our distance-based instrumental variable impracticable for these veterans. We followed veterans’ health care use through calendar year 2015. We stopped following a veteran in the month he or she joined a Medicare Advantage plan or dis-enrolled from Part B. As described below, we defined VA reliance based on the number of evaluation and management (E&M) visits in Medicare and the VA, and so we excluded

veterans with no such visits before becoming ineligible by joining Medicare Advantage, losing Part B, or death.

Data on VA health care use came from the outpatient treatment files (OTP) in the VHA corporate data warehouse (CDW) (Fihn et al. 2014; US Department of Veterans Affairs 2018). These databases have encounter-level data that record the procedures delivered on the visit as defined by common procedure terminology (CPT) codes, the type of provider, and codes representing the type of outpatient clinic. We excluded clinic codes for emergency or institution-based services including hospital services and long-term care. We included data from the VA outpatient fee-basis file, which includes outpatient care for veterans who were referred to community providers by VA clinicians, and records procedures using CPT codes.

Data on Medicare health care use came from the Physician/Supplier files, which also use CPT codes, and codes to identify the type of provider and place of service (VA Information Resource Center 2015). We restricted the place of service codes to noninstitutional, noninpatient settings. Carrier claims for services provided in hospital outpatient settings were included. Dates of death came from the VHA Vital Status File, which incorporates dates of death recorded by the Centers for Medicare and Medicaid Services (CMS).

Information about VA hospitalizations was obtained from the CDW for VA hospitalizations and from the Medicare Provider Analysis and Review file for Medicare hospitalizations (VA Information Resource Center 2015). Annual measures of comorbidity burden were developed using diagnosis codes on Medicare and VA inpatient and outpatient records employing methods described by Gagne et al. (2011).

Categories of Health Care Use

We used Berenson Eggers Type of Service (BETOS) codes to categorize outpatient health care use. There are 99 BETOS codes: each code corresponds to a group of CPT codes. BETOS codes were developed by CMS officials to track noninstitutional health care cost and use. There are no BETOS codes for services that the VA provides but CMS does not cover, so by using BETOS codes we restricted the analysis to the types of services that could occur in both Medicare and VA administrative databases. We selected 28 BETOS codes that are primarily used in outpatient settings for this analysis.

Primary Exposure: Reliance on the VA

We defined reliance on the VA based on the number of E&M visits to primary care, specialty care, and mental health in the VA relative to Medicare. We defined a veteran as VA-reliant if she or he had more E&M visits in the VA than Medicare over a given time period and Medicare-reliant otherwise. Only E&M visits to physicians or nurse practitioners were included. We did not include E&M visits to pharmacists or other nonphysicians who cannot bill for Medicare services.

We chose E&M-based metrics rather than metrics based on total costs or total visits for several reasons. First, we wanted a metric that measured the degree to which a veteran relied on VA providers to orchestrate his or her care, and E&M visits are essential for orchestrating care. E&M visits provided by non-VA clinicians through a fee-basis referral from a VA clinician were not included in the VA reliance measure, as referral to fee basis is one way that VA clinicians orchestrate a patient's care. Second, we did not want to use total costs or total visit to define reliance because this would bias a measure of reliance toward providers who recommended many procedures or had a particularly expensive style of care. Third, we excluded hospitalizations from the metric because in emergent situations veterans may be taken to the nearest appropriate hospital, rather than the facility that is orchestrating their care. Finally, we chose not to restrict the metric to only primary care E&M codes because of the large number of E&M codes provided by specialists and mental health professionals in both the VA and Medicare.

Statistical Methods

To distinguish the characteristics of veterans who chose to rely on the VA, we compared LHSEV responses to questions on demographics, social risks, health status, and health behaviors between VA-reliant and CMS-reliant veterans, where reliance was defined by E&M visits over the entire follow-up period. LHSEV supplied survey weights were used in this analysis. To estimate the association between VA reliance and survival, we estimated Cox proportional hazard models of survival as a function of baseline characteristics and VA reliance defined over the entire follow-up period. Survival times were censored when a veteran became ineligible due to Medicare Advantage enrollment or loss of Part B.

To estimate the association between VA reliance and outpatient health care use in the VA and Medicare, we estimated bivariate probit models

(Greene 1990) of the form:

$$y_{1it}^* = \beta_0 + r_{it-1}\beta_1 + w_{it-1}\beta_2 + x_i\beta_3 + t\beta_4 + e_{1it} \quad (1)$$

$$y_{0it}^* = \alpha_0 + r_{it-1}\alpha_1 + w_{it-1}\alpha_2 + x_i\alpha_3 + t\alpha_4 + e_{0it} \quad (2)$$

$$\begin{bmatrix} e_{1it} \\ e_{0it} \end{bmatrix} \sim \text{MVN}\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}\right)$$

where the y_{1it}^* and y_{0it}^* represent the unobserved latent probability of patient i receiving a given BETOS procedure in Medicare and the VA, respectively, in year t , which we observe as $y_{jit} = 1$ if $y_{jit}^* > 0$ and zero otherwise (for $j = 1, 0$); r_{it-1} is a dichotomous measure of VA reliance ≥ 50 percent in the prior year; w_{it-1} represents prior year hospitalizations in Medicare or VA and prior year values for the Gagne comorbidity index calculated using Medicare and VA data; x_i included baseline responses from the LHSEV for demographics, social risks, health status, and health behaviors; and t is time. The errors e_{1it} and e_{0it} are assumed to be distributed multivariate normal (MVN) with mean = 0, variance = 1, and correlation ρ . The coefficients α_1 and β_1 measure the association between VA reliance and the probability of VA and Medicare use of the procedure, respectively. We used the estimated coefficients from this model to predict the marginal probabilities of procedure use from VA or Medicare providers assuming a veteran was VA- and Medicare-reliant in the prior year, respectively, and present ratios of those predicted probabilities as adjusted risk ratios. We estimated robust standard errors clustered by individual to account for the multiple observations per patient. The standard errors of the risk ratios were estimated using the delta method.

Instrumental Variable Analysis

The results of above the analysis may be biased if there are systematic unobserved health differences between VA-reliant and CMS-reliant veterans. To address this, we estimated instrumental variables (IV) models. The key to an IV analysis is to find a naturally occurring variable that, like the random assignment in a clinical trial, sorts patients into treatment groups but has nothing to do with the outcome, except possibly through the treatment received. We used a measure of the relative distance from each veteran's ZIP code of residence to the nearest VA medical center and Medicare hospitals as our IV. Specifically, we subtracted the distance to the nearest Medicare hospital from the distance to the nearest VA medical center and divided by the standard deviation of the distances to the nearest 10 facilities (Medicare or VA). This standardized relative

distance is both theoretically and practically preferred to other distance measures. Theoretically, it should be equally applicable in remote areas where distances between hospitals are large, and in densely settled areas where distances between hospitals are comparatively small. This is not true of distance or relative distance; a 10-mile travel difference between a VA and Medicare hospital could seem like a small difference in a rural area but a prohibitively large one in a densely settled area. Practically, as described below, the standardized relative distance balanced the observed covariates of LHSEV respondents better than did either a distance or relative distance measure, and the correlation of standardized relative distance with VA reliance was strong. We calculated straight-line distances between residential and facility ZIP code centroids using the haversine formula (Wada 2009) to generate the instrument. The instrument varied over time for veterans who changed ZIP codes.

We tested the strength of the instrument in predicting VA reliance by the F-statistic from a linear probability model of reliance as a function of the exogenous variables in (1) and the instrument. To lend some credibility to the assumption that the IV was unrelated to outcomes except through VA reliance, we compared standardized differences in each of the baseline characteristics across high and low values of the instrument. For the survival analysis, we employed the IV using two-stage residual inclusion (Terza, Basu, and Rathouz 2008). We estimated a logistic regression of VA reliance ≥ 50 percent as a function of other exogenous variables in (1) and the IV, calculated the response residual, and added it as an additional variable in the Cox survival model. For the effect of reliance on procedure use, we used IV bivariate probit. Simulations (Basu, Coe, and Chapman 2018) suggest IV bivariate probit is superior to two-stage residual inclusion for dichotomous outcomes with dichotomous treatment, and appropriate for measuring the average treatment effect. We estimated equations similar to (1) and (2) except the dependent variable in equation (1) was lagged VA reliance and the standardized relative distance instrument was included as a regressor, and the outcome in equation (2) was a dichotomous variable equal to 1 if the veteran received a given procedure in a given year regardless of the system that provided the procedure.

All statistical analyses were conducted in *Stata* 15.0 (StataCorp 2017).

RESULTS

Among the 18,428 veterans who completed the 1999 LHSEV and who turned 65 in 1998, 1999, or 2000, we eliminated 8,273 who gained Medicare

eligibility due to disability, 2,934 who had no Part B or were in a Medicare Advantage plan in 2000, 312 who had no E&M visits in the follow-up period, and 25 who lived in Alaska or a US territory at baseline (Figure 1). Of the 6,884 veterans in the study, 4,317 veterans had more E&M codes in the VA than Medicare over the subsequent 15 years and are labeled VA-reliant; 2,567 veterans were Medicare-reliant (Figure 1). Among VA-reliant veterans, 86.5 percent of their E&M encounters were with VA providers; for Medicare-reliant veterans, this figure was 19.7 percent. Compared with Medicare-reliant veterans, VA-reliant veterans were less likely to be white and were similar in gender. VA-reliant veterans had fewer eligible years of follow-up because they were more likely to join Medicare Advantage plans or forego paying Medicare Part B premiums than were Medicare-reliant veterans. On a per person-year basis, Medicare-reliant veterans received more of each of the outpatient services we considered (Table 1).

VA-reliant veterans had significantly greater social risks, including low education, being unmarried and living alone, and having issues of

Figure 1: Consort Diagram

Table 1: Study Characteristics of Medicare-Reliant and VA-Reliant Veterans

	<i>CMS-Reliant</i>	<i>VA-Reliant</i>	<i>p-Value</i>
Count	2,567	4,317	
Age in 1999, mn (SD)	65.1 (0.815)	65.1 (0.818)	0.841
Female, % (<i>n</i>)	2.84 (73)	3.06 (132)	0.614
Race, % (<i>n</i>)			0.000
White	81.0 (2079)	74.6 (3220)	
African American	6.00 (154)	10.6 (458)	
Hispanic	3.54 (91)	4.70 (203)	
Mixed race	4.29 (110)	4.49 (194)	
Other/unk	5.18 (133)	5.61 (242)	
SF-12 PCS, mn (SD)	36.3 (11.4)	35.4 (11.2)	0.001
SF-12 MCS, mn (SD)	44.5 (13.2)	42.2 (13.3)	0.000
Gagne comorbidity score*, mn (SD)	0.98 (1.28)	0.60 (1.09)	0.000
Survival years of follow-up, mn (SD)	12.5 (5.52)	11.7 (5.93)	0.000
Eligible years of follow-up, mn (SD)	10.5 (4.95)	8.64 (5.29)	0.000
Hospitalizations per person-year, mn (SD)	0.92 (1.31)	0.90 (1.70)	0.707
VA E&M visits per person-year, mn (SD)	1.51 (1.60)	4.88 (6.25)	0.000
CMS E&M visits per person-year, mn (SD)	6.15 (5.42)	0.76 (1.37)	0.000
VA visits per person-year, mn (SD)	1.78 (1.85)	5.70 (7.46)	0.000
CMS visits per person-year, mn (SD)	7.71 (6.99)	1.01 (1.79)	0.000
Disposition at study end, % (<i>n</i>)			0.000
Enrolled in FFS	30.4 (780)	20.9 (902)	
Joined HMO	17.3 (443)	21.9 (946)	
Lost Part A/B	2.30 (59)	8.41 (363)	
Died	50.1 (1285)	48.8 (2106)	
Procedures per eligible person-year, mn (SD)			
Standard imaging			
Chest	2.52 (4.52)	1.67 (3.82)	0.000
Musculoskeletal	1.14 (1.37)	0.84 (1.13)	0.000
Contrast GI	0.12 (0.41)	0.08 (0.21)	0.000
Nuclear medicine	0.75 (1.08)	0.48 (0.90)	0.000
Other	0.56 (1.24)	0.43 (0.97)	0.000
Advanced imaging			
CAT: Head	0.35 (0.75)	0.26 (0.54)	0.000
CAT: Other	0.86 (1.46)	0.64 (1.47)	0.000
MRI: Brain	0.15 (0.56)	0.08 (0.24)	0.000
MRI: Other	0.20 (0.37)	0.10 (0.32)	0.000
Heart, including cardiac cath	0.30 (0.69)	0.13 (0.64)	0.000
Sonography			
Eye	0.08 (0.15)	0.04 (0.12)	0.000
Abdomen/pelvis	0.24 (0.47)	0.19 (0.45)	0.000
Heart	0.97 (1.50)	0.58 (1.74)	0.000
Carotid arteries	0.17 (0.30)	0.10 (0.24)	0.000
Other	0.32 (0.61)	0.20 (0.50)	0.000

continued

Table 1. *Continued*

	<i>CMS-Reliant</i>	<i>VA-Reliant</i>	<i>p-Value</i>
Ambulatory procedures			
Cataract/lens	0.13 (0.35)	0.07 (0.23)	0.000
Eye other	0.11 (0.39)	0.05 (0.21)	0.000
Skin procedures	1.05 (1.97)	0.64 (1.47)	0.000
Musculoskeletal procedures	0.04 (0.16)	0.02 (0.13)	0.000
Inguinal hernia repair	0.01 (0.04)	0.01 (0.05)	0.000
Minor procedures—Skin	0.84 (1.34)	0.59 (1.13)	0.000
Minor procedures Musculoskeletal	0.44 (0.97)	0.18 (0.66)	0.000
Oncology			
Oncology, other than radiology	0.46 (3.49)	0.27 (1.65)	0.000
Tests			
Electrocardiograms	1.83 (2.29)	1.24 (2.11)	0.000
Cardio stress tests	0.32 (0.51)	0.16 (0.41)	0.000
EKG monitoring	0.11 (0.29)	0.07 (0.22)	0.000
Other			
Chemotherapy	0.45 (3.42)	0.30 (4.22)	0.000
Vaccination	1.39 (0.91)	1.26 (0.89)	0.000

*Mean Gagne score over eligible person-years.
Medicare-reliant = Medicare E&M visits > VA E&M visits; mn, mean; PPY, per eligible person-year; SD, standard deviation; VA-reliant = VA E&M visits ≥ Medicare E&M visits.

food insecurity than did Medicare-reliant veterans (Figure 2). VA-reliant veterans also had significantly worse self-reported health as measured by the general health question or the SF-12 and had worse self-reported health behaviors including smoking, alcohol consumption, and lack of exercise (Figure 2).

Mean years of survival was lower for VA-reliant veterans, and the hazard rate for mortality remained elevated for VA-reliant veterans after adjusting for the baseline characteristics described in Figure 2 (hazard ratio 1.08; 95 percent confidence interval (CI) 1.01–1.16), although the survival disadvantage was eliminated in the IV analysis (hazard ratio 0.90; 95 percent CI 0.52–1.55) (Table 2).

In the standard bivariate probit models of procedure use, prior year reliance on Medicare was associated with statistically significantly higher use of 24 of the 28 procedures we studied (Figure 3).

Tests of the validity of standardized relative distance as an instrument found that the instrument was not highly correlated with other exogenous variables (Figure S1 in Appendix SA2). The sum of the absolute value of the standardized differences in exogenous variables between VA-reliant and

Figure 2: Differences in Baseline Characteristics between VA-Reliant and Medicare-Reliant Veterans [Color figure can be viewed at wileyonlinelibrary.com]

Medicare-reliant veterans was 378.8, and 14 variables had standardized differences >10 percent, which is a commonly used metric of imbalance. In contrast, the absolute value of the standardized differences between higher- and lower-

Table 2: Hazard Ratios from a Standard Cox Model of Survival as a Function of VA Reliance and an Instrumental Variable Cox Model

	<i>Model 1: Standard Cox</i>		<i>Model 2: IV Cox model</i>	
No. of subjects	6,884		6,884	
No. of deaths	3,413		3,413	
	<i>Hazard Ratio</i>	<i>95% CI</i>	<i>Hazard Ratio</i>	<i>95% CI</i>
VA-reliant	1.08	1.01, 1.16	0.90	0.52, 1.55
First-stage response residual			1.22	0.70, 2.12
Age				
65 (ref)				
66	1.12	1.02, 1.22	1.12	1.02, 1.22
67	1.21	1.11, 1.33	1.21	1.11, 1.33
Female	0.84	0.69, 1.04	0.85	0.69, 1.04
Race				
White (ref)				
African American	0.98	0.86, 1.10	1.00	0.87, 1.14
Hispanic	0.84	0.69, 1.03	0.86	0.70, 1.05
Mixed race	0.91	0.77, 1.08	0.92	0.78, 1.08
Other/unknown	0.97	0.78, 1.20	0.97	0.79, 1.21
Employment				
Working (ref)				
Unemployed	1.34	0.99, 1.80	1.35	1.00, 1.82
Not in labor force	1.14	1.01, 1.28	1.14	1.01, 1.28
Unable	1.28	1.11, 1.47	1.28	1.12, 1.47
Missing	1.19	0.89, 1.59	1.19	0.89, 1.59
Marital status				
Married (ref)				
Divorced/separated	1.22	1.10, 1.35	1.24	1.11, 1.40
Widowed	1.36	1.17, 1.57	1.38	1.18, 1.61
Never Married	1.24	1.05, 1.45	1.26	1.06, 1.50
Missing	0.90	0.65, 1.23	0.90	0.66, 1.24
Education				
<High school	0.99	0.90, 1.08	0.99	0.90, 1.09
High school (ref)				
College	0.95	0.88, 1.03	0.94	0.86, 1.03
Missing	0.98	0.84, 1.13	0.97	0.84, 1.13
No VA copay	1.01	0.93, 1.10	1.01	0.93, 1.10
Lives Alone				
No (ref)				
Yes	0.97	0.87, 1.08	0.98	0.87, 1.09
Missing	1.24	1.06, 1.44	1.24	1.06, 1.45
Food availability concerns				
No (ref)				
Yes	1.00	0.89, 1.12	1.01	0.90, 1.13
Missing	1.09	0.74, 1.59	1.10	0.75, 1.62

continued

Table 2. *Continued*

	<i>Hazard Ratio</i>	<i>95% CI</i>	<i>Hazard Ratio</i>	<i>95% CI</i>
Someone to take you to doctor				
No (ref)				
Yes	1.05	0.94, 1.17	1.04	0.93, 1.16
Missing	0.89	0.62, 1.27	0.89	0.62, 1.27
Self-reported health				
Excellent (ref)				
Very good	0.88	0.64, 1.21	0.90	0.65, 1.24
Good	1.04	0.77, 1.41	1.06	0.78, 1.43
Fair	1.20	0.88, 1.64	1.22	0.89, 1.67
Poor	1.58	1.13, 2.21	1.60	1.14, 2.24
Missing	1.22	0.88, 1.69	1.23	0.89, 1.71
SF12 Physical component score	0.99	0.99, 1.00	0.99	0.99, 1.00
SF12 Mental component score	1.00	1.00, 1.01	1.00	1.00, 1.01
# of health conditions	1.05	1.03, 1.07	1.05	1.03, 1.07
BMI category				
Under weight	1.25	0.99, 1.58	1.25	0.99, 1.58
Normal weight (ref)				
Overweight	0.79	0.72, 0.86	0.79	0.72, 0.86
Obese	0.86	0.78, 0.95	0.87	0.78, 0.96
Missing	0.90	0.74, 1.09	0.90	0.74, 1.10
Ever smoked 100 cigarettes				
No (ref)				
Yes	1.20	1.08, 1.34	1.20	1.08, 1.34
Missing	1.18	0.75, 1.86	1.18	0.75, 1.86
Current smoker				
Do not smoke (ref)				
Every day	1.65	1.51, 1.80	1.66	1.51, 1.82)
Some days	1.56	1.35, 1.79	1.57	1.36, 1.82
Missing	1.15	0.75, 1.77	1.15	0.75, 1.77
Alcohol use				
Never	1.03	0.90, 1.18	1.03	0.90, 1.18
1-3× month (ref)				
1/week	0.86	0.67, 1.11	0.87	0.67, 1.12
2-6/week	0.97	0.81, 1.16	0.97	0.82, 1.17
Daily	1.02	0.79, 1.32	1.02	0.79, 1.32
More than daily	1.27	1.05, 1.53	1.29	1.06, 1.57
Missing	1.13	0.89, 1.43	1.13	0.89, 1.43
Exercise				
None	1.18	1.07, 1.31	1.18	1.07, 1.31
<1/wk (ref)				
1-2×/wk	0.91	0.80, 1.03	0.90	0.79, 1.02
3-4×/wk	0.82	0.72, 0.93	0.82	0.72, 0.93
5+×/wk	0.93	0.81, 1.07	0.93	0.81, 1.06
Missing	1.19	0.85, 1.69	1.18	0.83, 1.67

Figure 3: Adjusted Risk Ratios from Bivariate Probit Models on the Association between Medicare Reliance and Outpatient Procedure Use [Color figure can be viewed at wileyonlinelibrary.com]

Note. $N = 54,065$ observations on 6,541 individuals. Unadjusted probabilities of receiving each procedure for VA- and Medicare-reliant veterans, respectively, are shown on the right y-axis. The adjusted risk ratios are on the x-axis. A risk ratio >1.0 means Medicare reliance >50 percent in a given year is associated with a higher probability of procedure use in the subsequent year.

than-average values of the instrument was 140.6, which represents a 63 percent reduction in the imbalance in exogenous variables, and only one variable had a standardized difference >10 percent. The instrument was strongly correlated with VA reliance. The F -statistic on the instrument from a linear regression of the instrument and the exogenous variables on VA reliance ≥ 50 percent was 340.7 ($p < .001$).

The IV estimates (Table 3) suggest larger effects of Medicare reliance on the probability of procedure use, but also significantly greater uncertainty in the estimates. Twenty-four of the 28 estimates suggest a positive effect of Medicare reliance on the probability of procedure use, but only 10 of the bivariate probit IV estimates were statistically significant at the $p \leq .05$ level. In addition, the estimated adjusted risk ratio of 6.8 on EKG monitoring was implausibly large.

DISCUSSION

We examined a cohort of veterans who became age-eligible for Medicare some time in 1998–2000 and tracked their outpatient health care use in the VA and Medicare over the subsequent 15 years. We found that the veterans who chose to rely on the VA for their care were among the most vulnerable veterans. They had greater health and social risks, and significantly poorer health behaviors than did veterans who chose to rely on Medicare providers for their care. Nevertheless, Medicare-reliant veterans were more likely to receive 24 of the 28 outpatient imaging, tests, and other outpatient services we considered. The evidence for a causal effect of Medicare reliance on procedure use was strongest for the use of advanced imaging and cardiac testing, which was corroborated by instrumental variables analysis. Despite the favorable risks and elevated outpatient use, Medicare-reliant veterans had a modest survival advantage that was not corroborated in instrumental variables analyses.

Our findings have important implications for VA policy. First, the Choice Program, which expands access to community care on a fee-for-service basis, is likely to be expensive. Developing the ability to predict and manage the costs of paying for care that veterans receive in the community will be critical. Unlike Medicare, the VA receives a fixed budget from Congress. Unplanned excess expenditures due to a more aggressive practice style of community providers would require requests for additional funds from Congress.

Table 3: Instrumental Variable (IV) Bivariate Probit Model of the Effect of Medicare Reliance on the Probability of a Procedure Use

<i>Procedure</i>	<i>Bivariate Probit IV Adjusted risk ratio (95% CI)</i>
Standard imaging	
Chest	1.4 (1.1, 1.7)
Musculoskeletal	1.2 (0.8, 1.6)
Contrast GI	2.9 (0.9, 4.9)
Nuclear medicine	2.9 (1.7, 4.1)
Other	1.0 (0.4, 1.6)
Advanced imaging	
CAT: Head	1.6 (0.8, 2.4)
CAT: Other	1.6 (1.1, 2.1)
MRI: Brain	2.5 (1.2, 3.8)
MRI: Other	1.1 (0.2, 2.0)
Heart, including cardiac cath	3.1 (1.4, 4.9)
Sonography	
Eye	1.4 (0.1, 2.6)
Abdomen/pelvis	1.1 (0.5, 1.7)
Heart	3.2 (2.2, 4.1)
Carotid arteries	2.1 (0.7, 3.6)
Other	1.6 (0.6, 2.6)
Ambulatory procedures	
Cataract/lens	1.5 (0.4, 2.6)
Eye other	1.6 (0.3, 2.8)
Skin procedures	0.9 (−0.4, 2.1)
Musculoskeletal procedures	3.6 (−3.5, 10.6)
Inguinal hernia repair	0.1 (−0.0, 0.3)
Minor procedures—Skin	1.4 (0.2, 2.6)
Minor procedures musculoskeletal	2.8 (0.9, 4.6)
Oncology	
Oncology, other than radiology	0.9 (−0.7, 2.4)
Tests	
Electrocardiograms	1.7 (1.3, 2.1)
Cardio stress tests	3.0 (1.5, 4.4)
EKG monitoring	6.8 (3.3, 10.4)
Chemotherapy	1.0 (−0.2, 2.3)
Immunization	0.8 (0.6, 1.0)

Note. $N = 54,065$ observations on 6,541 individuals. Adjusted risk ratios >1.0 reflect more procedure use among Medicare-reliant than VA-reliant veterans. Bold text represents statistically significant differences between Medicare- and VA-reliant veterans ($p < .05$).

Several factors related to the supply of and demand for care may contribute to the more aggressive style of care provided to Medicare-reliant veterans. On the supply side, Medicare providers in this study were reimbursed on a fee-for-service basis, so had little economic incentive to order fewer services.

The lower use among VA-reliant veterans may also reflect supply constraints at the VA. VA clinicians may be more judicious in their use of VA resources for imaging and testing if those resources are overstretched. If a service or procedure is not available in a timely manner at a VA facility, a VA clinician may request that the veteran receives care at a community provider through the fee-basis program. These requests require the approval of the medical center directors, and the added administrative burden of obtaining approval may discourage testing and procedures of marginal clinical value. The lower use of outpatient services within VA might also reflect a culture of a more parsimonious approach to medical care. This is consistent with previous studies that compared the VA to fee-for-service Medicare for cancer-related imaging (McWilliams et al. 2014) and is similar to how certain regions of the country exhibit more aggressive or parsimonious styles of medical care (Fisher et al. 2003). A recent study suggested that physician practice style is an important source of regional variation in health care costs. Cutler et al. (2017) gave clinical vignettes to cardiologists in high- and low-cost hospital referral regions and found that about 60 percent of the variation in end-of-life costs among hospital referral regions could be explained by physician variation in preference for aggressive versus comfort care. Future studies should explore whether a similar preference for conservative care exists among VA clinicians.

On the demand side, the higher use among Medicare-reliant veterans may be due to time-varying increases in patient need, or higher unobserved demand for services by Medicare-reliant veterans in comparison with VA-reliant veterans. We addressed this in the instrumental variables analysis. We found that veterans who live close to a VA medical center in comparison with the distance to Medicare hospitals were more likely to use the VA, but did not differ substantially on a fairly extensive list of individual characteristics measured by the LHSEV. If we assume that relative distance is also uncorrelated with unobserved characteristics that might cause veterans to use more Medicare and to demand more aggressive treatment, then the IV estimates can be interpreted as a causal effect of Medicare use on procedure intensity.

The balance of the evidence from other studies also suggests that patient demand plays a comparatively small role in regional variation in costs. The Cutler et al. (2017) study that administered clinical vignettes to clinicians also administered vignettes to patients and concluded that a relatively small fraction of the variance in costs (9 percent) could be attributed to patient demand factors. This finding is consistent with those of other studies (Anthony et al. 2009; Baker, Bundorf, and Kessler 2014), although Finkelstein et al. (Finkelstein, Gentzkow, and Williams 2016) estimated a somewhat larger role for

patient demand. They studied Medicare beneficiaries who moved from low-spending to high-spending regions and concluded that approximately half of the increased spending was due to patient demand and half to provider factors.

While Medicare providers in the present study provided more aggressive care to Medicare-eligible veterans, they were not necessarily providing lower value care. The value of care must also take account of patient outcomes and satisfaction. Survival did not differ substantially between Medicare-reliant and VA-reliant beneficiaries, and hospitalization rates were similar, but we did not measure patient satisfaction, quality of life, or functional status beyond baseline measures. Future studies should address whether the more aggressive outpatient practice style provided to Medicare-reliant veterans is mitigated by improved patient satisfaction with care and functional outcomes.

A second important finding of this study is that veterans who chose to rely on the VA had significantly higher social and health risk factors and significantly worse health behaviors than did veterans who chose to rely on Medicare providers. VA policies such as reduced copayments for low-income veterans and veterans with disabilities already draw the most vulnerable veterans to the VA. Increasing access to community care will likely accentuate this. In the present study, the VA's core constituents—the veterans who chose to stay with the VA when they were given a choice of VA or community providers—were the most disadvantaged of an already vulnerable population of veterans.

This study demonstrates the value of linking VA and Medicare data, and builds on the pioneering work of Burgess et al. (2011) and others in combining VA data with Medicare data to address important policy questions. The key insight of Burgess et al. (2011) was that commonalities in the data structures between VA administrative data and Medicare outpatient claims made direct comparisons of care between VA and Medicare possible. In the present study, this linkage was valuable because fee-for-service Medicare is a good analogue for the Choice Program; Medicare and Choice providers are community clinicians reimbursed on a fee-for-service basis. Linking VA data with fee-for-service Medicare data gave us insights into the aggressive style of care veterans are likely to receive through an expanded fee-for-service Choice Program.

The linkage to survey data also provided some unique insights. The linked LHSEV provided data on social risks and health behaviors that are not easily obtained from administrative data, and these survey-reported measures differed substantially between VA- and Medicare-reliant veterans and were highly significant in the analysis of survival differences. Linking to survey data

also allowed us to test assumptions about the correlation between our proposed instrumental variable and health behaviors that would not be possible with only administrative data.

LIMITATIONS

The study has important limitations. Three issues suggest a conservative bias to our estimates. First, we adjusted for lagged hospitalizations and comorbidity. If more Medicare reliance is associated with more aggressive treatment and diagnosing in time period t , then using hospitalizations and comorbidity to adjust procedure use in $t + 1$ would tend to reduce the adjusted difference in procedure use between Medicare- and VA-reliant cohorts. Second, the study sample excluded veterans when they enrolled in a Medicare Advantage plan. Medicare Advantage enrollees tend to be healthier on average than fee-for-service enrollees (Atherly, Hebert, and Maciejewski 2005) and a higher proportion of VA-reliant compared to Medicare-reliant veterans joined Medicare Advantage. This would leave a disproportionately unhealthy selection of VA-reliant veterans in the study sample. Third, survival upon joining an HMO was superior to VA-reliant than Medicare-reliant veterans (hazard ratio 0.74; $p < .001$, Table S2 in Appendix SA2). The modest survival disadvantage of VA-reliant veterans (hazard ratio 1.08; $p = 0.047$) diminished (hazard ratio 1.02; $p = 0.16$, Table S1 in Appendix SA2) if we did not censor survival at enrollment into Medicare Advantage.

We studied only veterans age 65+ so it may not generalize to younger veterans, although the supply factors that affect service use would likely be similar. We had detailed health and health behavior data from the LHSEV, but LHSEV respondents were surveyed only once, at baseline. We had no time-varying self-reported or functional measures of health that might explain greater use of services among Medicare-reliant veterans. Finally, although we focused in the manuscript on the probability of receiving a given BETOS rather than the total number of procedures received, we also estimated two-part negative binomial models (Manning et al. 1981; Belotti et al. 2015) (Table S3 in Appendix SA2), which indicated that the primary effect of Medicare reliance on procedure use was through the probability of having a procedure, not the number of procedures among veterans who had at least one.

CONCLUSION

Improving access to care for veterans through greater use of community care on a fee-for-service basis is likely to be expensive to the VA and will likely result in the most disadvantaged veterans receiving care from VA providers. Unlike Medicare, the VA receives a fixed budget from Congress and it will be absolutely critical to develop the ability to predict and manage the costs of paying for care that veterans receive in the community, while still providing care to the most vulnerable individuals.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix SA1: Author Matrix.

Appendix SA2: Results of Tests for the Appropriateness of the Instrumental Variable, Sensitivity Analyses Regarding the Survival Analysis, and Results of the Two-Part Negative Binomial Models.